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Automated Command and Control Information Systems (ACCIS) and CAX

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To be prepared for war is one of the most effectual means of preserving peace.

-George Washington

Abstract:

This paper provides an introduction to the relationship between an Automated Command and Control Information System (ACCIS) and Computer Assisted Exercises (CAX). After a brief historical review the paper gives an overview of existing definitions and descriptions of ACCIS and CAX. Based on a common sense understanding of the phenomena, the term "Operational Environment Simulation (OES)" is introduced. Common capabilities of ACCIS and OES are then identified as Common Services. It is concluded that both the ACCIS and the OES have much in common. It is recommended that future developments of ACCIS should follow the same standards and guidelines in order to maximize training benefit of CAXes and in order to minimize costs of development, operations and management of both systems. The NATO ACCIS architecture attempts to do exactly this.

Introduction

Since Field Marshal Montgomery developed NATO Command Post Exercise (CPX -1), which was held in April 1952 and attended by all of the top commanders in NATO and the national chiefs, five decades have passed. These five decades have seen an unprecedented technical revolution: the revolution of the information age. The information age is having a dramatic impact on all sectors of society: from the behavior patterns of the family to the phenomenon of globalization. The impact on military processes is in no way less dramatic: whereas in 1952, paper maps, grease pencil, mechanical calculators, lots of human brains formed the support core of military management or command and control, this core is becoming more and more computer based today. In 1952 command post exercises (CPX) were stimulated by response cells consisting of staffs mainly supported by the manual tools, similar to those used in the military management system. Developing computer tools to aid the decision process has been an endeavor almost right from the invention of the computer at the end of WWII. And indeed military requirements and funds were the driving force for the creation of such tools. First pushed by the need to find the enemies' crypto graphical methods and keys, the computer was created. The revolution of the information age however took off with the invention and affordability of the microprocessor in the 70ties, the Internet[1] in the 80ties and the world wide web (WWW)

[1]) Das Internet ist die am schnellsten wachsende Struktur, die je vom Menschen geschaffen wurde. *(Zitat: Prof. Rudolf Beyer, Institut für Informatik der TU München)*. Approximate Translation: "The Internet is the fastest growing structure ever created by the humanity".

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in the 90ties. We can attribute the first two phenomena to military funds whereas the WWW came from scientific world. Today's developments in information and communications technology (ICT) are largely driven by industry and commerce.

The technology of Command Post Exercises, like any civil and military sector, has been taking part in this revolution. The traditional Kriegsspiel[2] has been giving way to computer supported simulations. NATO for the first time conducted a Computer Assisted Exercise (CAX) in 1989, called ACE '89. Response cells (RC) were equipped with a set of simulation models, simulating air, ground and naval engagements. Exercise controllers and response cells were equipped with their own command and control information system. The concept of the Operational Environment Simulator (OES), entailing computer based models **and** automated CCIS both to assist exercise support staff was born shortly thereafter[3].

Already in the 80ties first ideas were published on interfacing the then emerging automated command and control information systems (ACCIS) with the simulators. In order to be effective and efficient, the implementation of these interfaces for the purpose of computer assisted exercises (CAX) however had to wait for the information and communications technology (ICT) of the 90ties. The implementation is ongoing….

The Problem

Computer Assisted Exercises (CAX) are conducted usually in order to reach one or both of the following objectives:

- to exercise and train staff in the accomplishment of their missions and tasks,
- to test and verify organizations, procedures and tools of command and control systems.

Both objectives require the staffs which are being **exercised or trained** or which **operate and use tools for test and verification** purposes to be exercised using the tools which they would use in support a command and control problem in the real world. A command and control problem whether for real or for CAX could address a peace support mission, military crisis management or conflict resolution, it could deal with a strategic problem, an operational problem or a tactical problem. It could deal with a single staff function, with an entire functional area (FA), a complete headquarters, or a multi-echelon command structure. There are types of CAX, which support any combination of the above, just as there are many operational environments in the real world.

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[2]) See www.aimonline.com/history.htm: "Wargaming has a long history and has throughout the ages, changed history's path, either directly or indirectly. Wargaming has had more of an effect on the course of human events than is realized by most people. It all started around 3000 B.C., in China, with a man named Sun Tzu. A general and the earliest known philosopher on the subject of warfare, Sun Tzu also created the first known war game." …."The major breakthrough in wargaming didn't come until 1811 in Prussia. In that year, Baron Von Reisswitz, a civilian war counselor in the Prussian court in Breslau, invented a game called **Kriegsspiel** (The War Game). Baron Von Reisswitz introduced the game to the Prussian princes Wilhelm and Friedrich and they were so impressed by it, that it was adopted by the Prussian military to practice on-the-field command decisions. The game was played on a sand covered table and used wooden playing pieces to represent the different types of units. The rules covered movement and the effects of terrain. Combat was resolved using an odds table. Lieutenant George Heinrich Rudolph Johann Von Reisswitz, from the Prussian Guard Artillery and son of Baron Reisswitz, modified his father's game and made several improvements. He replaced the sand on the table with colored squares to indicate different terrain types. The young Lieutenant also modified the rules to include battalions of infantry and fusiliers, squadrons of cavalry and dragoons and because of his own military experience, rules were added to include the use of field artillery and siege guns. **Kriegsspiel** was played by Prussian military officers to prepare for battles and was given credit by Prince Wilhelm as helping in the Prussian victories of 1870. Such an influential and popular game, couldn't be contained for long and **Kriegsspiel** found its way to Italy, Russia, Japan and in 1867 the United States. …."

[3]) Schmidt, W.H.P.: Computer-Assisted Exercises (CAX), A Technological Challenge To Nato; STC-PP-305, Aug-92; presented at AFCEA Brussels October 1991.

Just as the tools in support of staff functions and residing on the ACCIS need to interoperate with the real world for solving real world problems, they need to interface with the simulated virtual world of a CAX. We call this virtual world the OES, the Operational Environment Simulator. There needs to be a conceptual SWITCH, which hooks the ACCIS either to the real world or to the virtual world. In doing so, there are obviously a number of INTEROPERABILITY requirements to be met. There are DATABASES involved, which need congruency of contents. There are APPLICATIONS and Computer Human Interfaces (CHI) Interfaces involved, which should be identical in order to reap the full training benefits.

Finally there is the philosophical question of concept: "Is the OES not part of ACCIS anyway?"

This lecture deals with these problems: the switch, interoperability and databases, applications and CHI as they are related to the OES and the ACCIS.

Before we get into the details of these topics we need to cover some definitions.

Definitions

ACCIS, the Automated Command and Control Information System

The glossary of terms attached to the **NATO C3 TECHNICAL ARCHITECTURE**[4] defines the "**automated command and control information system (ACCIS)" as "**A NATO programme to provide command and control information systems to support NATO military commanders". The same document provides the following Note: *"Use of this term" namely ACCIS " as a generic term meaning a command and control information system that has been automated is to be avoided. See also:* ***command and control information system***." Looking at "**command and control information system (C2IS, CCIS)" we find:** "An information system which provides military authorities with support for command and control purposes" with the following "Notes:

- *Command and control information system is complementary to command and control communication system.*

- *The term "command, control and information system (CCIS)" is recognized in certain older NATO documents to mean "an integrated system comprised of doctrine, procedures, organizational structure, personnel, equipment, facilities and communications which provide authorities at all levels with timely and adequate data to plan, direct and control their activities." Use of this term is to be avoided as well as the use of the abbreviation CCIS in that sense. " And it goes on with: "See also:* ***consultation, command and control****, and,* ***management information system***"

At this point it becomes useful to stop looking for definitions and instead to use an intuitive approach to ACCIS for the purpose of this lecture. The above considerations are nonetheless valuable as it opens the door to NATO's thinking on these topics.

The intuitive approach to ACCIS results in the following loose description: An ACCIS is a collection of computer supported tools which assist commanders and their staff in executing their command, control, consultation and management tasks. These tasks can be looked at from an information processing point of view as related to the command and control cycle (e.g. situation monitoring and assessment, planning courses of action, decision making, decision execution). They can also be looked at from a viewpoint of mission (consultation, management, command and control) and supporting military functions, such as Intelligence, Operations, and Logistics.

[4]) VOLUME II - ARCHITECTURAL DESCRIPTIONS AND MODELS (Version 2.0 [Dec 15, 2000] - ISSC NATO Open Systems Working Group)

CAX, Computer Assisted (or Aided) Exercise(s)

Unfortunately, the Glossary used so successfully above does not contain a definition of CAX. The Allied Command Europe (ACE) *CAX Planners Course* 1999[5] however provides a useful definition: A CAX is *"A Command Post Exercise (CPX) in which computer-based simulation models are used to place commanders, staffs and their command and control systems in an operationally realistic environment in order to perform decision-making, practice staff procedures and co-ordinate between headquarters."* The term "CPX" in turn is defined in the US DOD and the NATO Glossary of Terms as *"An exercise in which the forces are simulated, involving the commander, his staff, and communications within and between headquarters."* The conduct of a CAX therefore, by definition, requires a **computer based** Operational Environment Simulator (OES), including the simulated forces as a prime aspect.

After this common sense definition we shall not refrain from exhibiting some more descriptions[6].

- From **SHAPE**: An exercise in which the control-group conducting and controlling the exercise utilize computers and other advanced technology devices to simulate an operational environment to the commanders and staffs, who are the players or the primary training activity of the exercise.

- From **SACLANT**: CAX involves the specific use of computers in simulation of a range of joint military operations for both live and synthetic exercises and day-to-day training. CAX will provide the most beneficial contribution in synthetic exercises, particularly dynamic gaming which explores joint force capability and tactics in the new situations likely to be faced by NATO Forces in the future. Ultimately, NATO-wide CAX should be developed that employs a network of NATO and national computer systems to represent crisis situations in which force capabilities can be assessed and realistic training can be conducted.

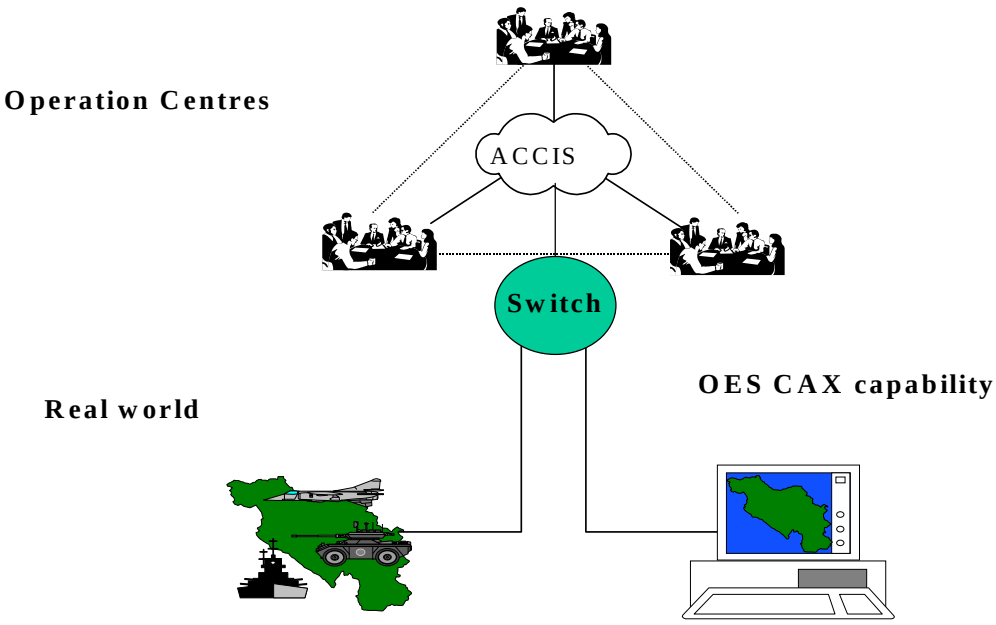
- **WARRIOR PREPARATION CENTER (WPC):** An exercise using computer models designed to place the command and control elements of headquarters in a realistic, stressful combat-like environment to stimulate decision making, command and control staff interaction and coordination at the operational-level of war.

Whereas these descriptions are fairly close to the common sense description above, LTSS 40 contains additional descriptions, which take a more general approach. For the purpose of clarity these descriptions are not being used here.

[5]) Unpublished presentation by NATO C3 Agency, The Hague, the Netherlands.
[6]) all from: NATO, AC/243(LTSS)TR/40, Final Report, COMPUTER ASSISTED EXERCISE TECHNOLOGY, DEFENCE RESEARCH GROUP,AC/243(LTSS), 15 Feb 1995.

Conceptual Architecture - The Switch

As shown below the ACCIS needs to operate in two modes: the Operational Mode (OM) and the Exercise Mode (EM).



Operational Mode (OM) and Exercise Mode (EM)

There needs to be a conceptual switch which performs certain actions inside the ACCIS and outside the ACCIS in order to interface the ACCIS to either the real world or the OES. In switching from OM to EM, inside the ACCIS the operational databases need to be deactivated. Instead of those the exercise databases come into play. Outside the ACCIS, the communications interfaces to the real world will be disconnected and instead those of the OES will be switched in. In reality however an ACCIS can never be completely in EM as certain vital real world watch functions must be operational 24 hours a day, 7 days a week. Hence in designing the ACCIS careful consideration must be given about the deactivation/ activation processes.

We shall first discuss the communications interfaces, then the data base aspects.

Communications Interfaces

In the OM the ACCIS communicates to its real world environment via its doctrinal communications systems. These systems carry a number of communications channels connecting it to other ACCIS elements belonging to this real world environment, namely ACCIS of the subordinate units, lateral units, higher echelons, governmental and non-governmental organizations, etc.. In a CAX only those doctrinal communications, which are subject of being exercised, are left in place as part of the ACCIS. All other communications elements in a CAX are represented by the OES. At certain points the doctrinal communications systems require to be interfaced with those of the OES. The OES therefore needs to have communications interfaces, which match those of the ACCIS. Whereas it seems to be a simple matter to switch the actual communication links from real world to OES, the doctrinal systems are complex and it is by no means trivial to make sure that the logical channels match.

Some typical communications capabilities in use are:

- The formal messaging systems, with their prescribed formats and transfer requirements, governed by protocols such as AdatP-3[7] for content and the MMHS protocol[8] for transfer purposes.

- The military Intranets, following closely the evolution of the standards governing the public Internet and commercial Intranets.

- Specialized point-to-point systems or circuit switched systems for highly responsive traffic (e.g. video conferencing).

The OES requires modules, which can match those capabilities of the ACCIS[9] in order to provide the primary training staff with experience to the utmost degree possible. If the training staff in the real world do their job for example by pulling information from the military Intranet then the OES needs to feed this Intranet with the required information. If the training staff gets information through the messaging mechanisms of the ACCIS those need to be supported by the OES as well.

The switch needs to make sure that the proper systems and protocols are activated in the ACCIS and the OES in time for the CAX to happen.

Databases

Types

In a military operation there are four types of data involved in the simulation environment:

- **Dynamic military unit data**, which contain information about type of unit, its strength, combat effectiveness, equipment, location, subordination ("order of battle"), posture, etc. The term unit means to cover all types including e.g. engineers, intelligence collectors, communication units, transportation, and headquarters. Those data change in the course of a campaign.

- **Static reference data**, which contain information about weapon characteristics, means of transportation, characteristics of sensors and electronic warfare emitters, personalities, etc. Those data by definition do not change during a campaign.

- **Geographic data,** which contain information about the terrain and geopolitics, such as national borders.

- **Weather data**, which are self-explanatory.

Dynamic Military Unit Data

Let me turn to the **dynamic military unit data** first. The ACCISs of nowadays and for some time to come have not achieved one single integrated database. Instead users, jointly with developers, have designed and implemented subsystems, which cover partial aspects of the total operation. In NATO those partial aspects are called "Functional Area Systems" or FASs. Whereas this situation is not ideal it has been the only way to make progress. The alternative would have been waiting for the coordinators to propose and agree

[7]) STANAG 5500:1987, NATO MESSAGE TEXT FORMATTING SYSTEM (FORMETS), Allied Data Publication 3 (ADatP-3).

[8]) MMHS PROFILES – e.g. AMH1x(MA) - Military Message Handling System (MMHS) - Common Messaging

[9]) For a more complete description of NATO's protocols see: http://194.7.79.15/ VOLUME 2 [ARCHITECTURAL DESCRIPTIONS AND MODELS] / PART 3. NC3TA REFERENCE MODELS

uniform approaches and definitions. Whereas this is tedious and loaded with many problems in a pure national environment, in NATO's 19 Nations it is and will remain a dream for some time to come.

Taken this as a given, the databases of the OES and the ACCIS nevertheless need to have congruency at least in content. In the preparation phase of an exercise the exercise databases of the ACCIS and the OES need to be initialized, in order to reflect the start situation of the exercise. Normally the exercise planner assisted by staff specialists from the functional areas would accomplish this. They would take a copy of the ACCIS database (we use the term database to mean the collection of all FAS databases, relevant to the exercise) declare this copy as the initial working copy of **the exercise database** and modify the data elements to fit the exercise scenario and the exercise objective. Once this work is completed, a transformation process takes these ACCIS exercise data and converts them into a form suitable to fit into the OES (the simulation database). Then the database of the OES is initialized. The transformation process usually involves structural conversions in order to make the data formats compatible with the simulation algorithms. Furthermore aggregation and/or de-aggregation may be required for the same reason.

Transformation/initialization are tedious processes, as in the normal case the OES and the ACCIS have been developed under different rules and standards. These processes are highly dependent on human input. In order to minimize errors which are easily introduced a verification process supported by an exercise visualization system is necessary. The end result of this work is that both, the ACCIS and the OES at exercise start have databases identical in contents, as far as the simulation impacts on the data re concerned. After start of the CAX the data of the OES are changed by the simulation and in turn changed in the ACCIS through the software and human elements, which implement the communication protocols, discussed above (see communications interfaces).

Static Reference Data

Static Reference Data contain information about weapon characteristics, means of transportation, characteristics of sensors and electronic warfare emitters, personalities, etc. Static reference data are exchanged once, before the start of the exercise. During execution these data remain unchanged. The process of initialization is identical to that for dynamic data however may not be necessary for each exercise as a repository will be increasingly available after each exercise.

Geographic Data

Geographic data require a special consideration for two reasons. Firstly, CPXs (which include CAXs) may operate in artificial terrain and geopolitical settings (in short geodata). The OM in ACCIS always operates on real world geographic and geopolitical data. Secondly the OES may employ a simulation model, which uses a representation of the real world, which may not be found in the ACCIS (if ACCIS operates simulation based decision support tools, they may well be found!). The ACCIS usually employs some form of a Geographic Information System (GIS). Military GIS usually obtains the geodata in formats supported by the national geographic institutions. There are three processes involved:

- Generating the Digital Geographic Products:
  - By National Survey Agencies and governed NATO Geo Policy

- Configuration of Operational GIS Database within HQs
  - By Chief Geo Officers and Regional Geo Policy

- Utilization of Geo Applications and Database in Operational ACCIS
  - Military Users and ACCIS Staff in Accordance with operational plans
  - Digital Atlas on Staff Officers' Desktop

The resulting digital geodata products are usually made available in the following formats: DCW[10], VMAP[11], ADRG[12], DTED[13]…. These formats may not be compatible with the algorithms used in the OES.

Hence there is the additional requirement of the GIS for format conversion: During the exercise initialization process the geodata bases in the ACCIS and in the OES require to be made identical in contents. The conversion process should be possible in both directions, as it is necessary to generate OES geodata from real world products and as it is necessary to generate ACCIS geodata in ACCIS format from products which have been generated on the OES as an artificial world. Geoproduct converters are available for a variety of formats.

Weather Data

Weather data in ACCIS are usually obtained from military and civil weather stations, including Internet supported facilities. In ACCIS these data are largely used for human interpretation, correlation and assessment. There are special ACCIS weather services, which deliver data, which can be processed automatically, such as for flight planning, artillery purposes.

In OES weather data are influencing calculated simulation results often without human intervention. Data structures containing weather data of the OES are therefore normally part of the simulation model. Their representation may therefore be totally incompatible that in the ACCIS.

Therefore software-based processes are required which are similar to those affecting dynamic military unit data (see above).

The Computer-Human Interface (CHI[14])

In any ACCIS or OES excellent familiarity with the CHI is part of the staffs' personal profile. Efficiency of staff work is vitally dependent on this capability. Hence one single CHI for OES and ACCIS must be the objective.

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[10]) The Digital Chart of the World (DCW) is an Environmental Systems Research Institute, Inc. (ESRI) product originally developed for the US Defense Mapping Agency (DMA) using DMA data.

[11]) See http://164.214.2.59/publications/vmap0.html: Vector Map (VMap) Level 0 is an updated and improved version of the National Imagery and Mapping Agency's (NIMA) Digital Chart of the World (DCW®). The VMap Level 0 database provides worldwide coverage of vector-based geospatial data which can be viewed at 1:1,000,000 scale. It consists of geographic, attribute, and textual data stored on compact disc read-only memory (CD-ROM). The primary source for the database is the 1:1,000,000 scale Operational Navigation Chart (ONC) series co-produced by the military mapping authorities of Australia, Canada, United Kingdom, and the United States. The complete database is available on a set of four CD-ROM's and contains more than 1,800 megabytes of vector data organized into 10 thematic layers. VMap Level 0 includes major road and rail networks, hydrologic drainage systems, utility networks (cross-country pipelines and communication lines), major airports, elevation contours, coastlines, international boundaries and populated places. VMap Level 0 includes an index of geographic names to aid in locating areas of interest. VMap Level 0 is accessible directly from the CD-ROM or can be transferred to a hard drive and used in many geographic information system (GIS) applications.

[12]) ARC Digitized Raster Graphics (ADRG): ARC (equal Arc second Raster Chart/map) Digitized Raster Graphics (ADRG) are digital raster representations of paper graphic products. Maps/charts are converted into digital data by raster scanning and transforming the map image into the ARC System frame of reference. Data collected from a single chart/map series and scale will be maintained as a worldwide seamless data base of raster graphic data with each pixel having a distinct geographic location.

[13]) see http://164.214.2.59/publications/specs/printed/DTED/DTED_1-2.html: PERFORMANCE SPECIFICATION:DIGITAL TERRAIN ELEVATION DATA (DTED);METRIC MIL-PRF-89020A,19 April 1996, SUPERSEDING MIL-D-89020, 28 May 1993

[14]) The term CHI is preferred over the term human computer interface (HCI), as it associates the analogy to the 'chi' in humans. See e.g. Angel Thompson: Feng Shui, ISBN 0-312-14333-8, 1996, pp 169-171.

Unfortunately both the ACCIS and the OES have been developed from different backgrounds (one from the world of command and control, the other from the world of operational research). In cases where differences do exist the training audience must not be exposed to the man-machine interfaces of the OES: The staff would be incorrectly trained and unlearning would need to take place.

Identicality of the CHI would deliver additional exercise benefits, as those staff, which operates the OES, would be 'exercised on the ACCIS' as well.

For the reasons above, any new development should follow the same CHI standards.

Fortunately much of this is becoming reality by default as the commercial and home based computer tools are converging and building blocks from theses environments are the most effective ones to use in the both the ACCIS and the OES. Office automation is an obvious example of this happening: the PC tools offered by Microsoft have a worldwide market share of over 90% [15] of the Operating System and Office Automation Market. Whereas this is most welcome from the viewpoints of training efficiency, we may not like it for other reasons[16].

ICT Services in ACCIS and OES

We have tried to show that there is not really much difference between the ICT (Information and Communication Technology) functionality required in the ACCIS and those required in the OES. The difference, if any at all, is in the emphasis: the ACCIS world has been created from the world of information management, communication and presentation; the OES world has been created from the world of Kriegsspiel, war gaming and simulation. Simulation models are nowadays being included in ACCIS, in order to answer the "what if questions" coming up during the planning and decision phase of the command and control cycle. Information management, communication and presentation tools are being included in the OES as part of the command and control support required by response cells, directing staffs, exercise analysts, etc..

The evolution of ICT, since a considerable number of years, shows a general trend of moving the system developer, integrator and end-user away from basic technologies to higher aggregated technologies, tools, and services.

OES designers/implementers draw from a large stock of higher aggregated services offering a variety of products serving specified groups of basic tasks. These services will have been built on more basic technologies by others and will be commercially and governmentally available. Examples for such services are Geographic Information Systems (GIS).

The "art" of building OES systems and ACCIS systems is to integrate these services into a system, which fulfils the exercise requirements. The requirements depend on training objectives that are derived from the mission (e.g. peace support, crisis management, conflict resolution).

[15]) http://ig.cs.tu-berlin.de/w2000/ir1/t06-01/: Technische Universität Berlin Informatik und Gesellschaft, Information Rules Wintersemester 2000, Vorlesung "Markt und Wettbewerb 3"

[16] *) http://www.zeit.de/1999/46/199946_microsoft_gates.html:"*Wohl selten hat jemand die verwirrenden Mechanismen der Softwareindustrie so klar und durchschaubar dargelegt wie Jackson in seinem sogenannten *findings of fact." (DIE ZEIT, 11. Nov. 1999).* Approximate tramslation:Rarely has anybody explained so clearly the confusing mechanisms of the software industry as judgeJackson in his *findings of fact.*

The following services are playing a major role in the design and implementation of OES and ACCIS systems. They are described in the remainder of this chapter summarizing the findings of LTSS 40 and adapting them to the status of today's ICT.

1. **Messaging and Collaboration**

Industry provides solutions for collaborative work that bridges people and knowledge, and maximizes investments in existing technology. Modular and standards-based software that easily integrates with different applications and operating platforms are available. These enable organizations of all sizes to communicate, collaborate, share knowledge and conduct operations both internally and via the Internet.

Network services put together different technologies in the communications area in order to achieve packages of integrated services. Web technology with its commercial-off-the-shelf (COTS) servers, search engines, indexing schemes, browsers, value added applications services and data provision have come a long way since the publication of LTSS 40. But the basic services seen by the LTSS at that time address and embrace them. Use of open standards and well-defined and supported protocols must be mandatory. By adhering to this principle the system developer will be able to select from a gigantic market place the best packages. These include[17]:

- Directory service
- Message Handling
- E-mail
- Wide Area Information Browsing Services ("portals"; WAP[18])

2. Communications Systems Planning Services

Communications Systems Planning Services will provide tools to plan the communications for CAX, i.e. the communications inside the OES and its interfaces to the doctrinal communications system of the ACCIS.. They will take into account commercial, governmental, and military services available to support an actual CAX in a specific geographical area.

3. **Security Services/Packages**

Security Services/Packages will bundle different technologies to build the necessary security boundaries between an ACCIS in EM and the OES. These services will be available as separate packages that could be used on commercial systems and by network providers. These services range from crypto services to firewalls.

4. **Object-oriented component based technology**

The object-oriented technology will allow sharing software written for different applications. This opens the way for using libraries that could be commercial, governmental or even open and public. 20 years after the launch of the PC, software "development" turns into "software production". For example using ActiveX/COM (component object model)-interfaces, software components can communicate with each other; hence the capabilities of highly sophisticated and well-tested components can be easily integrated and exploited. Different

[17]) see e.g. Microsoft Exchange, LOTUS Domino

[18]) Wireless Application Protocol

high-level applications will thus be built upon the same basic components – finally. Such components can be:

- Applications
- User interfaces
- Data
- Objects

5. Archiving and Retrieval Technology (A&RT)[19]

A number of commercial A&RT products are available and in use on some NATO ACCIS FASs.

A&RT search and categorization technology is available which provides a robust, fault-tolerant and 'infinitely' scalable approach to information retrieval -regardless of whether you are deploying a FAS portal or OES database site. Powerful indexing, which can bring together content from all ACCIS and OES information sources is available. NATO C2 and CAX rules and categorization techniques are to be applied consistently across all information. Whether information is contained in a workflow management repository, a Microsoft Word file on a server across the street, or an HTML file on a Web server across the country, A&RT can index and search it. Supported formats include PDF[20], XML[21], all popular business applications and structured data such as that found in ODBC[22] databases.

By brokering queries to the servers that are best able to handle them, (A&RT) can deliver the most robust, high-performance search and categorization capabilities available.

This means that no longer for each kind of information, like map or terrain data, or mass data like fittings and equipment an own service needs to be implemented and integrated with the others.

The functions supported by such a service include:

- Indexing
- Search
- Filtering
- Interpretation
- Correlation
- Presentation

[19]) Capability description taken from Verity K2

[20])PDF= Portable Document Format (PDF) is the open de-facto standard for the distribution of electronic documents world wide.

[21])XML= The Extensible Markup Language (XML) is the universal format for structured documents and data on the Web. See also www.nc3a.nato.int/symposia/xmlworkshop/home.html for "The NATO C3 Agency XML Workshop", Nov 1999.

[22]) http://www.microsoft.com/data/odbc/default.htm : Open Database Connectivity (ODBC) is a widely accepted application programming interface (API) for database access. It is based on the Call-Level Interface (CLI) specifications from X/Open and ISO/IEC for database APIs and uses Structured Query Language (SQL) as its database access language.

6. Multimedia Services

Multimedia systems will integrate different technologies to support the design of user interfaces giving new functionality regarding the interaction between users and between the user and the system (CHI) as well as capturing actions of users and system states. It includes:

- Video teleconferencing
- Sound
- Recognition of
  - Voice and Translation
  - Individuals (facial characteristics and expressions; body movement and gestures)
  - 3D-Pointing (Hand movements near or on large screen displays)
  - Freehand drawings, incl. handwriting
- Hyper information
- Radio/Television
- Remote Collaborative Work

The use of these services in OES and ACCIS systems is commensurate with the spread of multimedia systems in the commercial environment and the homes, today and tomorrow.

7 Rapid Prototyping, Simulation Demonstration Environments[23]

Basic technologies like the object-oriented technology and user interface technologies will support rapid prototyping and the generation of demonstration environments. To a far broader extend than today other services e.g. libraries as explained in item 4 above will be used. This service is very helpful for a user driven development of systems, both OES and ACCIS.

8 Office Automation Environment

Office automation packages include standard software packages like spreadsheets, word processing, desktop publishing, presentation, project planning etc. These packages are available on every hardware/software platform. The use of a common environment will streamline tasks and would improve the cost-effectiveness of OES and ACCIS. See also CHI above.

9 Workflow Management Systems

The next step after office automation in the sense of working in an integrated environment handling the different entities (including multimedia documents) in an office is the preparation, editing, distribution, updating of these entities and the organization and the support of collaborative work. Workflow Management systems will provide this service. The effective implementation of such a service requires careful systems analysis and discipline. If not done properly we can see organizational pitfalls. Effective commercial systems are available in abundance.

11 Automated Explanatory Briefings Associate

The Automated Explanatory Briefings Associate is based on techniques to access and present data at varying levels of abstraction based on models of users and tasks. It uses multimedia co-ordination of speech, text, and graphics.

[23])see e.g. www.dsdm.org

12 **Geographical Information Systems**

Geographical Information Systems (GIS) as a service in the future will be more than today's systems. They will include not only terrain and map data, representation, and display, but also information regarding political, economical, ecological, environmental, ethical, racial, and religious structures. The systems will include tools to retrieve, evaluate, analyze, and update the information provided. Gazetteer services are becoming richly available.

Conclusion and Recommendation

From the considerations in this paper it has become obvious that OES and ACCIS have many software commonalities covering the entire spectrum of communications interfaces and protocols, data bases, basic ICT services, applications support and CHI. In order to reap the full benefits for the user, in terms of readiness and efficiency it is mandatory that both systems are governed by the same standards. In order to produce cost-effective systems it is mandatory that the same tools are used in both systems. NATO has recognized these requirements: the OES has become a module of the ACCIS, at least in concept. The NATO C3 Architecture[24] is recommending the use of n-tier architecture of software. Clearly this recommendation stems from the technological trends of the next software generation. This software will have at least three tiers: A lean client, a number of applications servers and a number of client/server databases. OES and ACCIS applications will run on this architecture using and sharing the same components. It is highly recommended that the Nations take the same attitude.

Author

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Disclaimer

The conclusions and opinions expressed in this document are those of the author cultivated in the freedom of expression which is found in the fresh air and clear water of the Austrian alps. They do not reflect the official position of NATO, for which the author was working until 2000, nor do they reflect the position of the authorities of Germany, of which the author is a national, nor of the authorities of Austria, which is providing the author's "operational environment".

[24]) http://194.7.79.15/

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Automated Command and Control Information Systems (ACCIS) and Computer Assisted Exercises (CAX)

Walter H.P. Schmidt
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Overview

- Introduction
- The Problem
- Definitions
  - Automated Command and Control Information System (ACCIS)
  - Computer Assisted Exercises (CAX)
- Conceptual Architecture-The Switch
- Communications Interfaces
- Databases
- Computer-Human Interface
- ICT Services in ACCIS and OES
- Conclusions and Recommendations

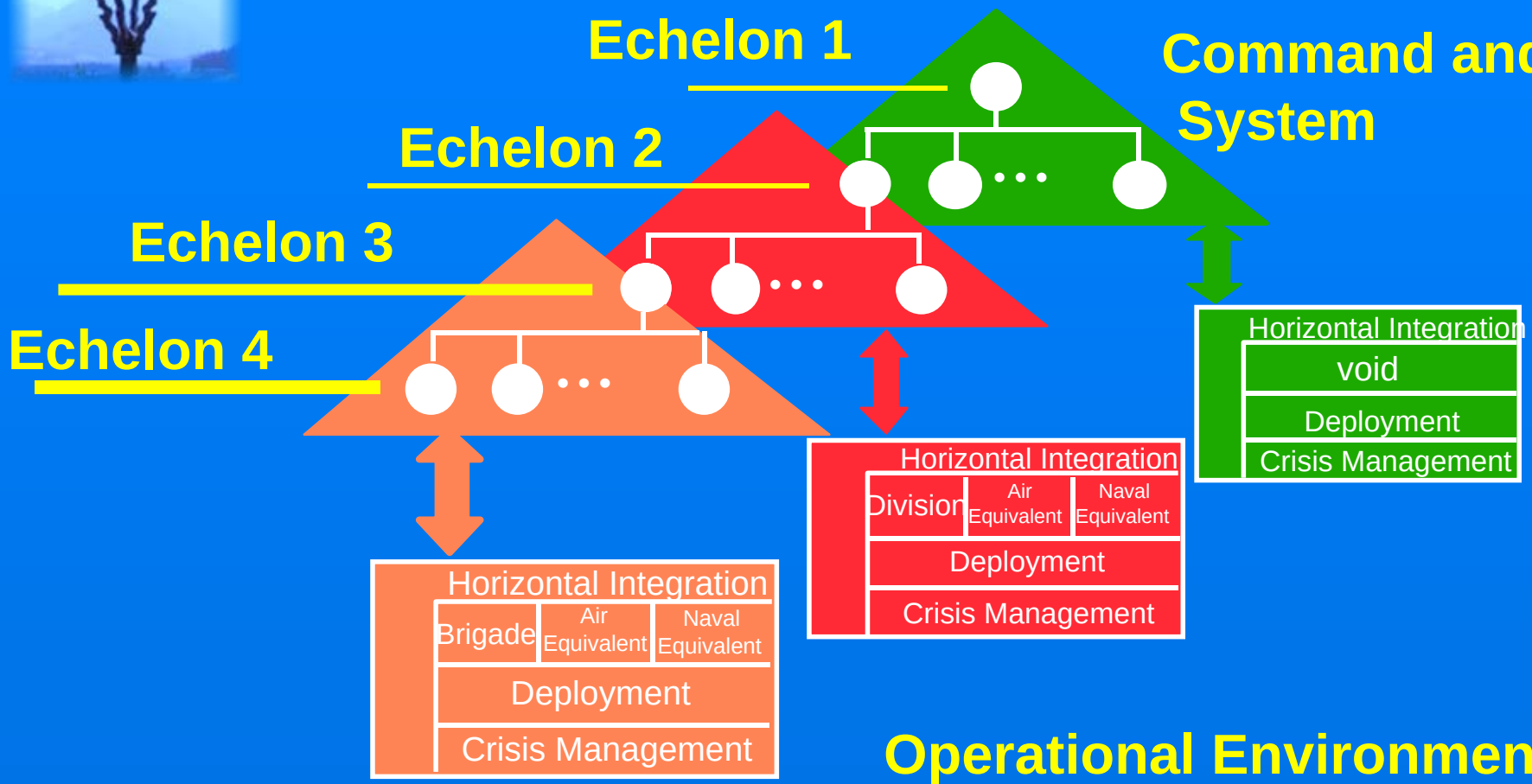
Introduction

- **Gaming-Exercising**
  - War Gaming in Prussia 1811
  - War Gaming in USA 1867
  - First NATO CPX 1952
  - First NATO CAX 1989
- **Information Age**
  - Mainframes (50/60ties)
  - Microprocessor (70ties)
  - PC (80ties)
  - Internet (80ties)
  - World Wide Web (90ties)

The Problem

- To exercise and train staff in the accomplishment of their missions and tasks
- To test and verify
  - organizations,
  - procedures and
  - tools of command and control systems

…from Functional Area (FA) to Multi-Echelon



Operational Environment Simulator (OES)

"Definition" of ACCIS

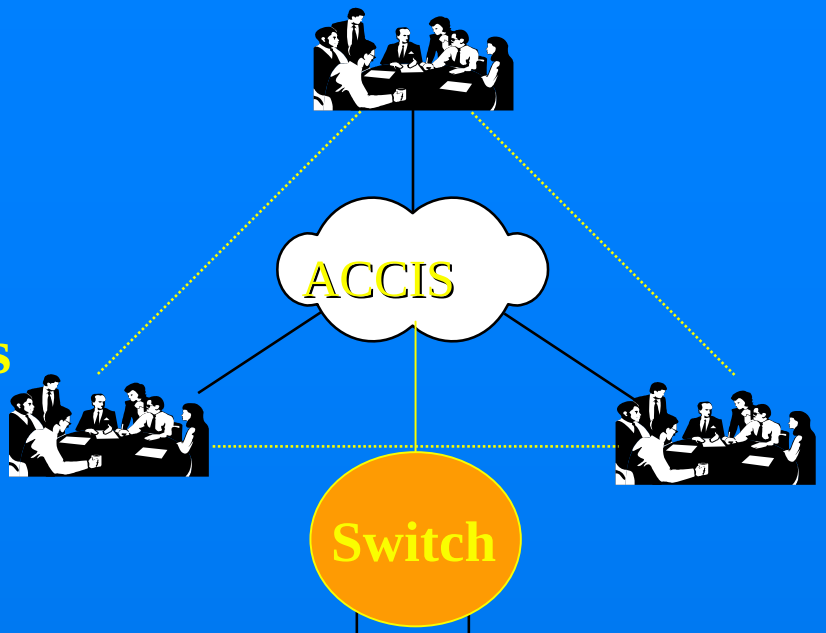
- ACCIS is a "collection" of computer supported tools which assist commanders and their staff in executing their command, control, consultation and management tasks
- Command and control cycle
  - situation monitoring and assessment
  - planning courses of action
  - decision making
  - decision execution
- Viewpoint of mission
  - consultation, management, command and control
  - military functions, such as Intelligence, Operations, and Logistics

Definition of CAX

A Command Post Exercise in which computer-based simulation models are used to place commanders, staffs and their command and control systems in an operationally realistic environment in order to perform decision-making, practice staff procedures and co-ordinate between headquarters.

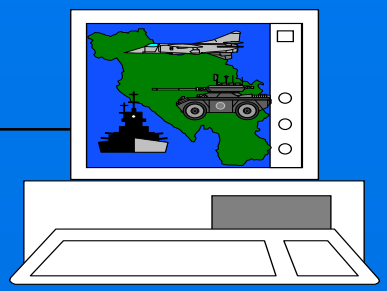
Source*: *ACE CAX Planners Course

- Functional Area
- Operation Centres
- Multi-Echelon



- Operational Mode (OM):
  - Real World

- Exercise Mode (EM)
  - Simulated World



ACCIS-CAX Requirements

- Interoperability
- Databases
- Applications
- Computer Human Interfaces

Exercise Mode

Exercise Preparation

ACCIS

OM DB

EM DB

dynamic scripting

OTHER FACTORS

- pol/mil events
- pol/civ events
- media

Ops Ctr

OPERATION CENTRES

ACCIS

Ops Ctr

Ops Ctr

response cells

simulation(s)

dynamic scripting

THEATRE OF OPERATIONS

- terrain
- mil/civ events and situation

ACCIS-OES Interoperability

Exercise Analysis

Exercise Preparation

Directing Staff

Exercise Control

Opposing Force

Situation Translation

Order Translation

Response Cells & Secondary Training Activity

Horizontal Integration

Vertical Inte-gration

Land | Air | Naval

Deployment

Crisis Response

Model Federation

Communications Interfaces

- At some point doctrinal communications needs to interface with the OES communications
- Formal Messaging
  - Content: STANAG 5500/ADat-P3
  - Envelope: MMHS
- Military Intranet
  - Informal e-mail
  - Web Access
  - “Public” Folders
- Specialized Point-to-Point Systems
  - Video Conferencing

DATA BASES

- Dynamic Military Unit Data
- Static Reference Data
- Geographic Data
- Weather Data

Dynamic Military Unit Data

- No integrated Data Bases as yet
- Partial aspects implemented in FA Systems (FAS)
- Congruency in Content needed
- ACCIS needs OM DB and EM DB
- EM DB Initialization as part of exercise preparation
- EM DB Update and Check-pointing via formal communications and exercise control as part of exercise conduct
- EM DB analysis using checkpoints as part of exercise analysis

Static Reference Data

- Data weapon characteristics, means of transportation, characteristics of sensors and electronic warfare emitters, personalities
- No integrated Data Bases as yet
- Partial aspects implemented in FA Systems (FAS)
- Congruency in Content needed
- ACCIS needs OM DB and EM DB
- EM DB Initialization as part of exercise preparation

- No change during conduct
- No check pointing needed

Geographic Data

- Real world terrain and geopolitical settings
- Artificial terrain and geopolitical settings

- Simulation model(s) may use representations of the geography which may not be found in the ACCIS

Generating the Digital Geographic Products

- **Generation of data**
  - National Survey Agencies, governed by NATO Geo Policy
- **Configuration of Operational GIS Database within HQs**
  - By Chief Geo Officers and Regional Geo Policy
- **Utilization of Geo Applications and Database in Operational ACCIS**
  - Military Users and ACCIS Staff in Accordance with operational plans
  - Digital Atlas on Staff Officers' Desktop

Geographical Information Services (GIS) Standards Found in ACCIS

- The Digital Chart of the World (DCW) is an Environmental Systems Research Institute, Inc. (ESRI) product
- Vector Map (VMap) Level 0 is an updated and improved version of the National Imagery and Mapping Agency's (NIMA) Digital Chart of the World (DCW®)
- ARC Digitized Raster Graphics (ADRG): ARC (equal Arc second Raster Chart/map) Digitized Raster Graphics (ADRG) are digital raster representations of paper graphic products
- DIGITAL TERRAIN ELEVATION DATA (DTED);METRIC MIL-PRF-89020A,19 April 1996
- Simulation models' algorithms may not be compatible with these standards. Some conversion routines are available

Weather Data

- ACCIS: usually obtained from military and civil weather stations, including internet supported facilities
  - human interpretation, correlation and assessment
  - special ACCIS weather services which deliver data for automatic processing, e.g. flight planning, artillery purposes
- OES: weather data are influencing calculated simulation results
  - Data structures containing weather data of the OES are part of the simulation model
  - Their representation may therefore be totally incompatible to ACCIS
- Conversions between ACCIS and OES are required

Computer-Human Interface (CHI)

- The objective must be the:
  - One single CHI for OES and ACCIS
  - Unlearning to be avoided
  - Primary and secondary training activity (RC) leran
- In Office Automation objective has almost been reached due to de facto MS standards

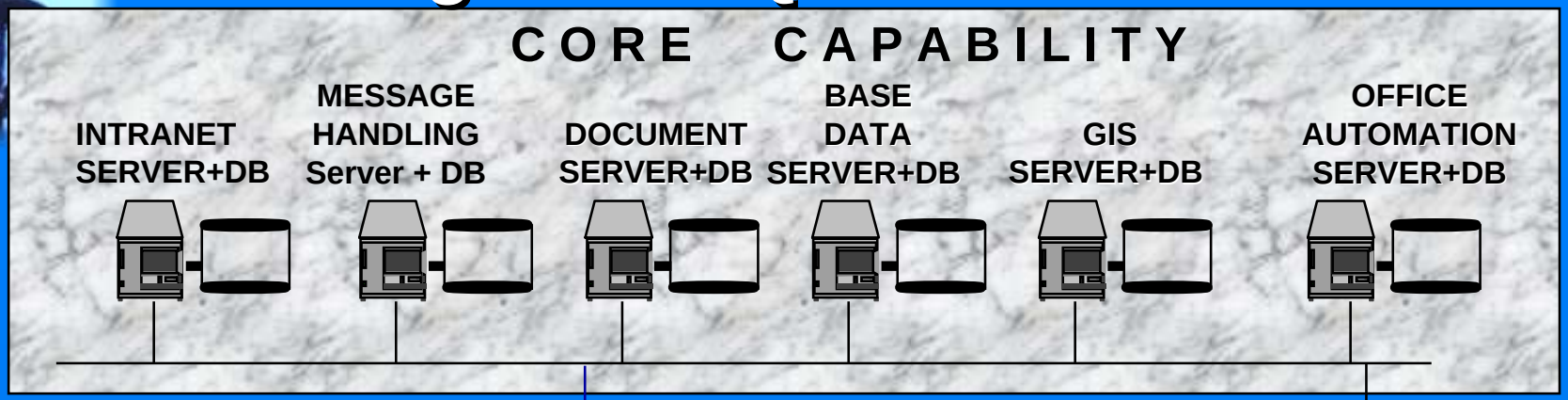
ICT & Services in ACCIS and OES

- **Services**
  - Messaging and Collaboration
  - Security
  - Archiving and Retrieval
  - Multi-media
  - Office Automation
  - Workflow Management
  - Geographical Information
  - Communication Planning
- **Object-oriented Component based Technology**
- **Simulation Operating Systems**
- **Rapid Prototyping, Simulation Environments**

Acquisition Strategy

- **OES is part of ACCIS**

Integrated HQ Node Architecture



CHI Client

Others
OES Servers+DB
LOGISTICS
INTELLIGENCE
OPERATIONS
COMMAND & CRISIS MNGMT

SYSTEM SUPPORT

ESSENTIAL ELEMENTS OF SUCCESS

- Realistic assessment of military requirements
- Evolutionary acquisition
- Rapid prototyping
- Open Systems Architecture
- Commercial-off-the-shelf modules
- Commercial standards
- Intensive user involvement
- Intensive industrial involvement
- Testbeds, testbeds, ...

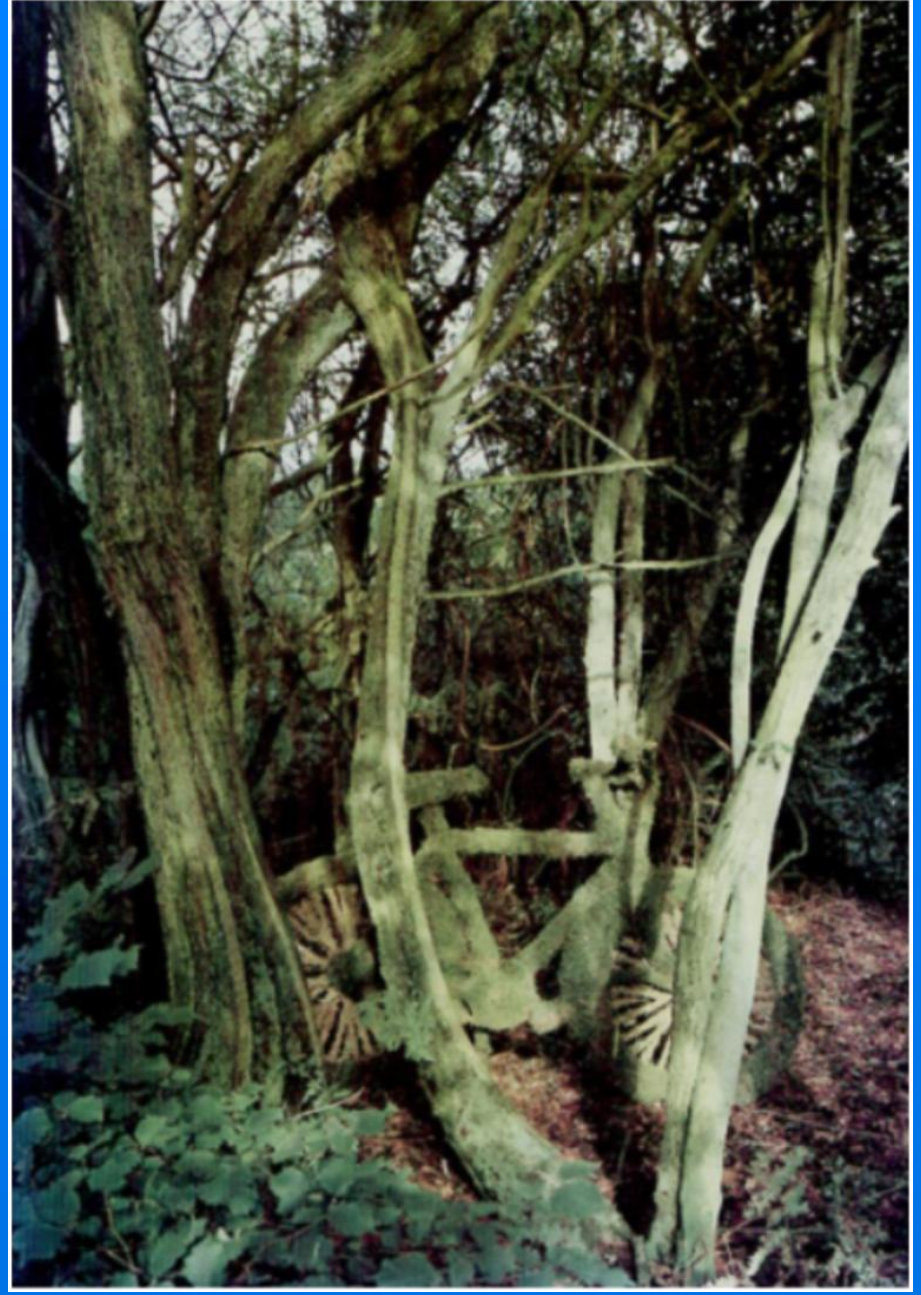
- Moss?
- Rain?
- Bicycle?
- Tropical Forest?

A transportation system procured with traditional methods:

- requirements analysis
- system specs
- contracting
- implementation

Guess what the user did, when the system was finally delivered?

Instead: build a little, test a little, build a little, ….



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